A New Technology for Continuous In-Situ Monitoring of Nutrient Levels of Ammonia & Nitrate to Meet NPDES Requirements

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“With over 400 miles of coastline, it's difficult to imagine any Rhode Islander left unaffected by the Bay's benefits. And not just the aesthetic joys and recreational enrichment it provides, but the influx of revenues that impact the fiscal well being of our state.

The Rhode Island General Assembly created the Narragansett Bay Commission (NBC) in 1980 to improve the water quality of Narragansett Bay and its tributaries. At that time nearly 45 million gallons of untreated or partially treated sewage flowed from the Field's Point Wastewater Treatment Facility in Providence into Rhode Island's waters every day, jeopardizing the state's and region's environmental well-being. Shellfishing beds were closed due to pollution, and travelers of the Bay reported seeing grease deposits the size of soccer balls floating on the water.

To combat these conditions, the NBC took over the failing facility from the City of Providence in 1982 and spent the next decade and over ninety million dollars rehabilitating and transforming the facility into a state-of-the-art, nationally recognized operation. In 1992, when the Field's Point facility's rehabilitation was complete, the NBC expanded its responsibilities to include the acquisition of the former Blackstone Valley District Commission and its Bucklin Point Wastewater Treatment Facility in East Providence.”

The Bucklin Point Wastewater Treatment Facility is the state's second largest wastewater treatment facility. Constructed in the early 1950's, the facility is located on the east bank of the Seekonk River in East Providence. Flow from Pawtucket, Central Falls, Cumberland, Lincoln, the northern portion of East Providence and a small section of Smithfield is conveyed through 28 miles of NBC-owned pipes to the Bucklin Point facility. The facility is designed to provide preliminary and primary treatment of incoming flows of approximately 50 MGD and secondary treatment to 31 MGD.”

Through its ownership and operation of the state’s two largest wastewater treatment facilities, the Narragansett Bay Commission serves over 40% of the population in Rhode Island and effects water quality improvements that benefit the entire state and Southern New England.

Description of the Project
Meeting effluent discharge requirements

The Narragansett Bay Commission wished to evaluate available technologies that would allow them to continuously monitor their effluent discharge of Ammonia for effective nutrient removal.

The decision was made to install an Isco-STIP Model PBS 1, NH4 (Ammonium) Process Buoy for purposes of this evaluation.

The Isco process buoy was installed at the Bucklin Point Wastewater Treatment Facility in East Providence RI, in the aeration basin to allow continuous monitoring of Ammonia as part of the nitrification process. The same device may also be used for measuring Nitrate; however, this parameter was not included as part of this evaluation.

Data from this evaluation will also to be provided to Carla Sangrey and Mike Kostur of Camp Dresser McKee Cambridge MA. Camp Dresser McKee is presently under contact with the Narragansett Bay Commission for plant upgrades at the Buckland Point Wastewater Treatment Facility.

Principles of Operation

The process buoys measure Ammonium or Nitrate through direct immersion in aeration basins or final effluent. The buoy is filled by the hydrostatic pressure of the water and emptied by air pressure. The process computer, housed in a weatherproof enclosure, can support two buoys of either type.

In addition to controlling the chemical analysis and parameter measurement, the onboard computer with its graphical user interface handles the operational control of all maintenance and test routines. Multitasking capability allows simultaneous handling of special and routine operations. For example, the operator can recall and view or print the stored parameter charts and maintenance data of the last fourteen-(14) days without interrupting the ongoing analysis and data acquisition. The built- in floppy disc drive allows storage of ninety (90) days worth of data on a single diskette. Data can be easily imported into popular spreadsheet programs like Excel.

It generally accepted that 30% to 40% of the cost of a conventional on-line cabinet-style wastewater analyzer, could be directly related to installation plumbing. These are costs above and beyond the actual equipment itself.

The unique design of the Isco-STIP Process Buoys eliminates the need for pumps in the wastewater as well as the need for on-line filtration devices. The package is designed for installation outdoors and can be installed within a few hours, which makes it particularly well suited to existing treatment plants and industrial applications. Valves within the buoy contact only air, reagents, and calibration standards, assuring a high level of reliability.

The buoy automatically calibrates itself daily using the standard addition method, and at the same time compensates for variability in the wastewater. (See figure 2)

Figure 1(a) & (b) shows a typical Process Buoy installed in an aeration basin.

Procedure

Samples were to be grabbed daily such that a comparison could be made between laboratory analysis and the Isco-STIP Process Buoy. This data would be used, as part of the evaluation criteria, to calculate a correlation factor to determine how well a continuous measuring device would trend with the laboratory results.

The samples were removed from the aeration basis using a rope and bucket procedure. The samples were taken just below the surface of the aeration basin in close proximity to the Isco-STIP Process Buoy.

The samples were drawn in 500ml glass containers and immediately taken to the Bucklin Point laboratory where they were preserved with sulfuric acid and adjusted to a pH less than two (2). The samples were kept refrigerated at a temperature of 4 degrees Celsius until they could be analyzed in at the Fields Point laboratory.

Mr. Taylor commented " the buoy was simple to install and maintain. Preventive maintenance consisted of a simple weekly cleaning of the settling chamber, analysis chamber and electrodes. At the end of the study we re-checked accuracy and reproducibility of addition of standard solution for the daily calibration and found results unchanged over a six week period."

Mrs. Cynthia Walters, Laboratory Manager, supervised the laboratory sampling and provided the data included in Table 1 of in this report.

The samples were analyzed using EPA approved method 4500-NH3A. This is a distillation method, in which sample preparation requires adjustment of pH to approximately 7.0 units, additions of borate buffer solution and readjustment of sample to pH 9.5 with 6N NaOH.

Summary

The Isco-STIP model PBS 1(Ammonium) Process Buoy was simple to maintain and installed within a matter of a few hours. This was particularly important since additional pumps, filtration devices and shelters were not required for installation.

One problem was encountered during the evaluation but service was excellent. The unit that was installed was found to need a new style solenoid valve. An upgrade of a solenoid was performed during the factory visit. The suggestion was made to the manufacturer to improve a design of lifting mechanism for a probe to make it easier for an operator to maintain a buoy.

The data shown in Table 1 represent a correlation of approximately 93% after one month of continuous operation with twenty discrete samples. The process buoy data tends to be higher than the lab due to the differences in the two methods. The Isco-STIP Process buoy uses EPA method 4500-NH3G, which requires adjusting pH greater than eleven (11). This converts all the Ammonium to Ammonia and accounts for the consistently higher readings.

Once an acceptable correlation factor is established, the Process Buoy Controller has a program, which allows direct overlap of both the lab and process buoy results if desired.

In conclusion, the Isco-STIP Process Buoy provided reliable, continuous monitoring of our mixed liquor, to optimize the nutrients removal process. It eliminated the delays in receiving laboratory results and also correlated extremely well with our own in house laboratory results.

Literature cited

http://www.narrabay.com
Isco/Stip Solutions for Wastewater Process Monitoring and Control

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Narragansett Bay Isco Ammonium Buoy Evaluation

Date	Lab	Buoy
	ppm	ppm
7-Jul	17.1	21.5
8-Jul	12.1	15.9
9-Jul	16.6	22.7
12-Jul	18.8	26.6
13-Jul	14.6	23.2
14-Jul	13.4	23.5
15-Jul	15.3	22.5
16-Jul	12.9	20.8
19-Jul	13.5	20.0
20-Jul	4.87	7.38
21-Jul	8.06	11.0
22-Jul	11.5	16.4
23-Jul	12.3	16.0
2-Aug	11.5	15.0
3-Aug	15.5	20.1
4-Aug	15.2	19.0
5-Aug	11.3	14.6
11-Aug	15.7	21.7
12-Aug	8.6	11.1
13-Aug	12.2	17.1
16-Aug	16.6	24.3
17-Aug	15.2	25.4
18-Aug	12.9	19.6
19-Aug	12.3	21.4
20-Aug	18.6	24.7
23-Aug	14.8	28.3
25-Aug	12.8	22.6
26-Aug	12.9	16.3
27-Aug	2.86	4.39
30-Aug	16.8	23.5
31-Aug	16.1	24.7
1-Sep	14.0	23.2
2-Sep	14.1	25.4
3-Sep	9.86	14.6
7-Sep	11.9	21.9
8-Sep	6.05	12.4
9-Sep	4.7	6.77
10-Sep	2.91	6.71
13-Sep	17.9	25.4
14-Sep	11.6	19.7
15-Sep	7.62	13.2
16-Sep	0.78	0.26
17-Sep	2.02	3.51
Average	**12.59**	**18.89**
Correlation		**93.78%**

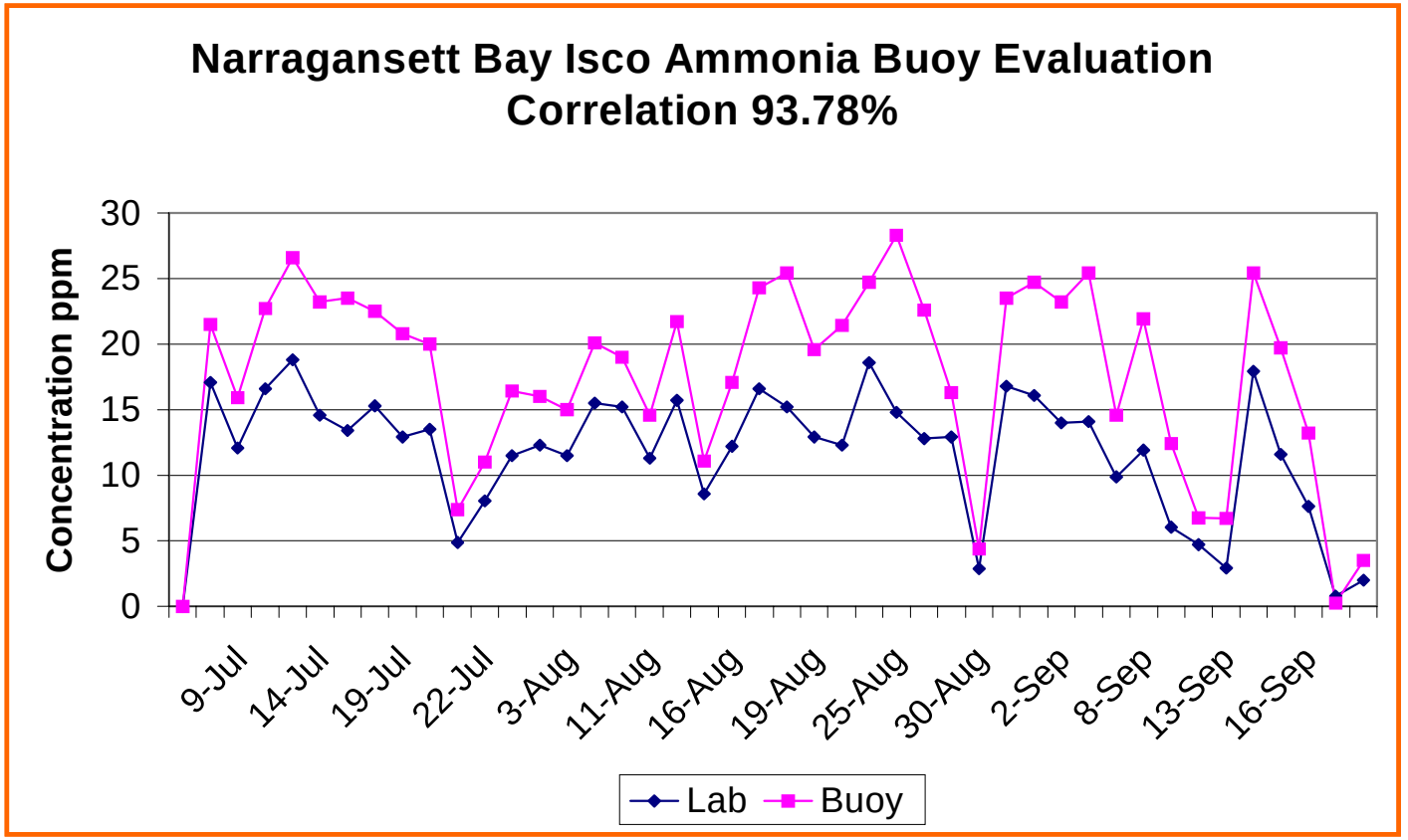


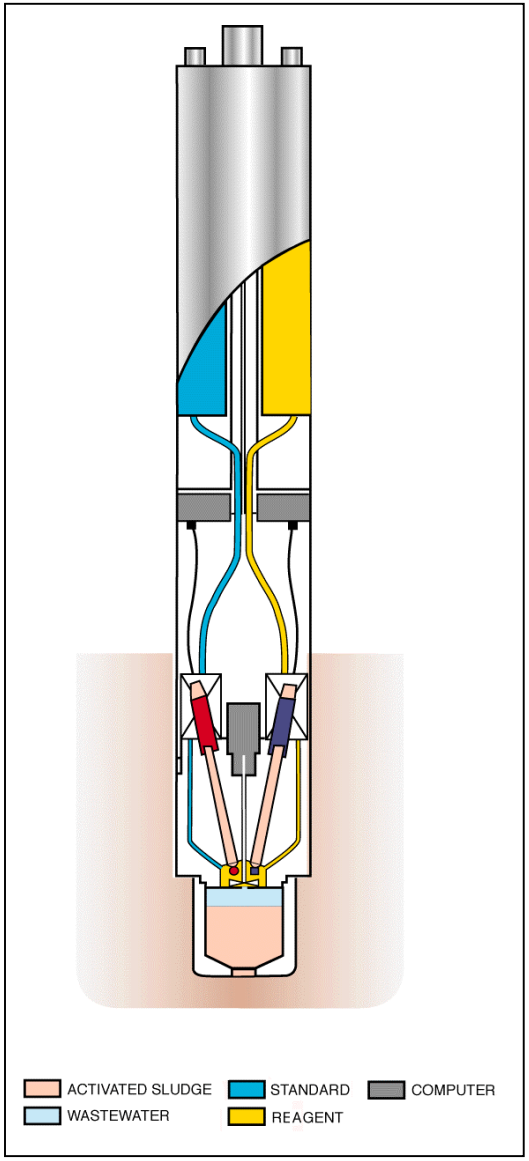
Figure 1(a)

Buoy installed in aeration basin

Figure 1 (b)

Graphical user interface & microprocessor controller

Figure 2



Buoy calibrates itself automatically